



Project Area 2

River Basin Groups D and E

Bacteria Impairments

TMDL

Texas Commission on Environmental Quality
James Miertschin & Associates, Inc.



Segment 1806 – Guadalupe River

- Placed on the 2000 §303(d) list because bacteria exceeded the segment specific criteria of 126 colonies per 100 ml (geometric mean) and 394 colonies per 100 ml (single grab).
- Designated Uses
 - Aquatic Life
 - Contact Recreation
 - Fish Consumption



Highway 16 Bridge – Station 12617





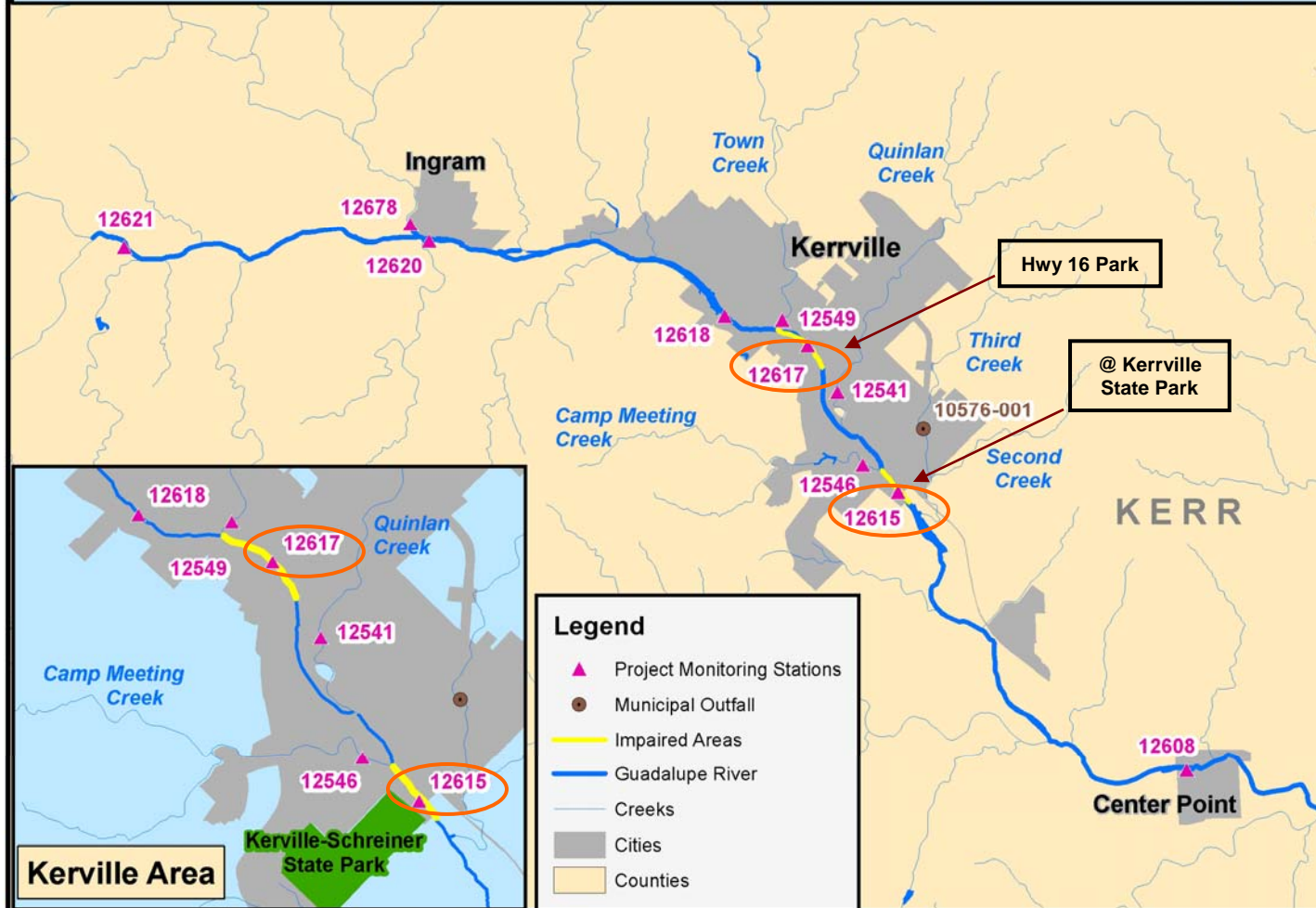
Kerrville State Park – Station 12615

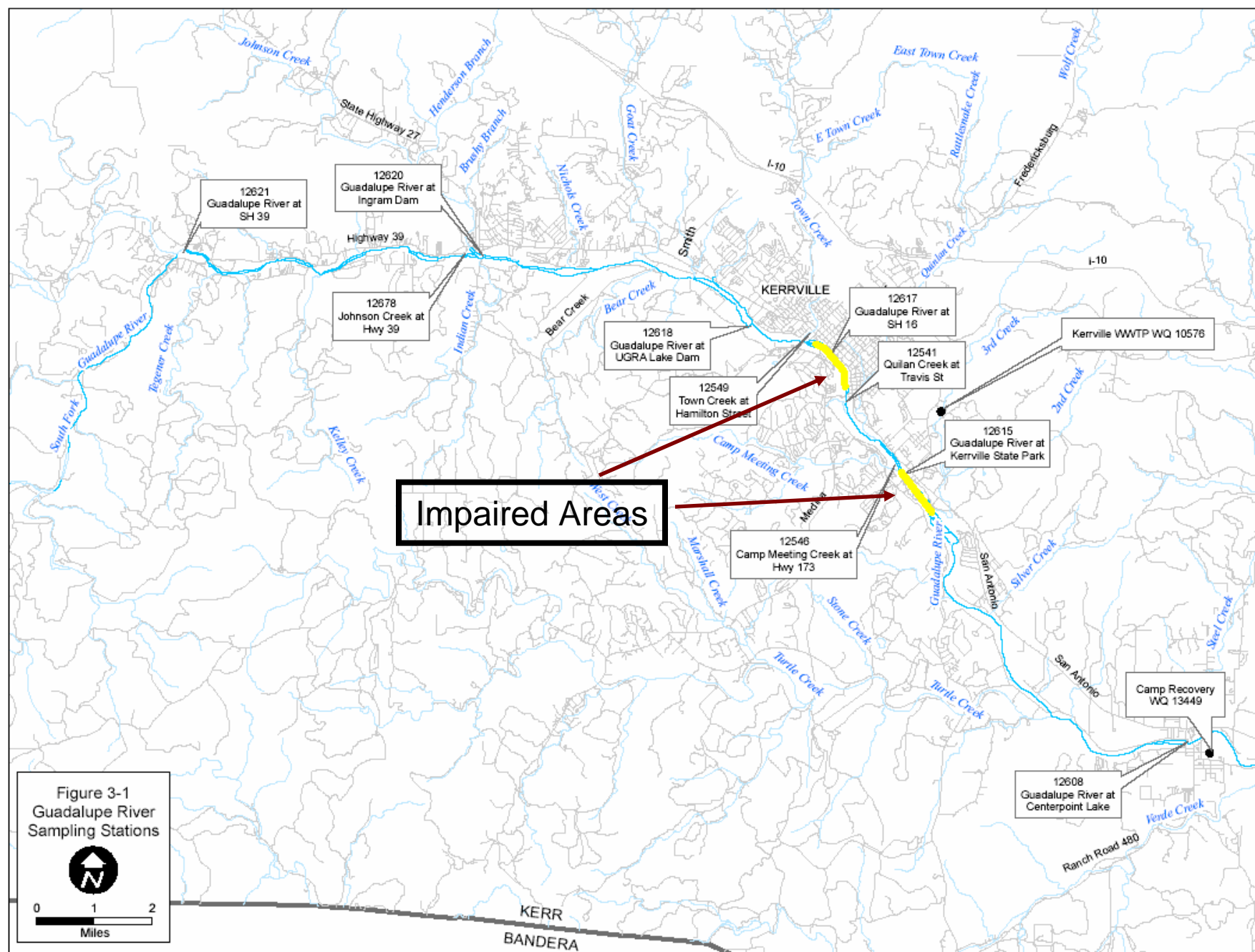


Map



Monitoring Stations Guadalupe River Above Canyon Lake (1806) TMDL Project





Guadalupe River *E. coli*/Fecal Coliform Geometric Means (2001-2004)



STATION	LOCATION	FECAL COLIFORM GEOMETRIC MEAN (Col/100 ml)	<i>E. COLI</i> GEOMETRIC MEAN (Col/100 ml)
12548	Indian Cr in Ingram (12548)	637	520
12549	Town Cr at Hamilton St (12549)	843	427
12550	Town Cr at Town Cr Rd (12550)	842	43
12617	Guadalupe R at SH 16 (12617)	761	355
12616	Guadalupe R at G St (12616)	228	69
16244	Guadalupe R at fotbridge in L. Hays Park (16244)	213	76
16243	Guadalupe R at L. Hays Park Dam (16243)	228	131
12541	Quinlan Cr at Travis St (12541)	579	208

Guadalupe *E. coli*/Fecal Coliform Geometric Means – Cont'd

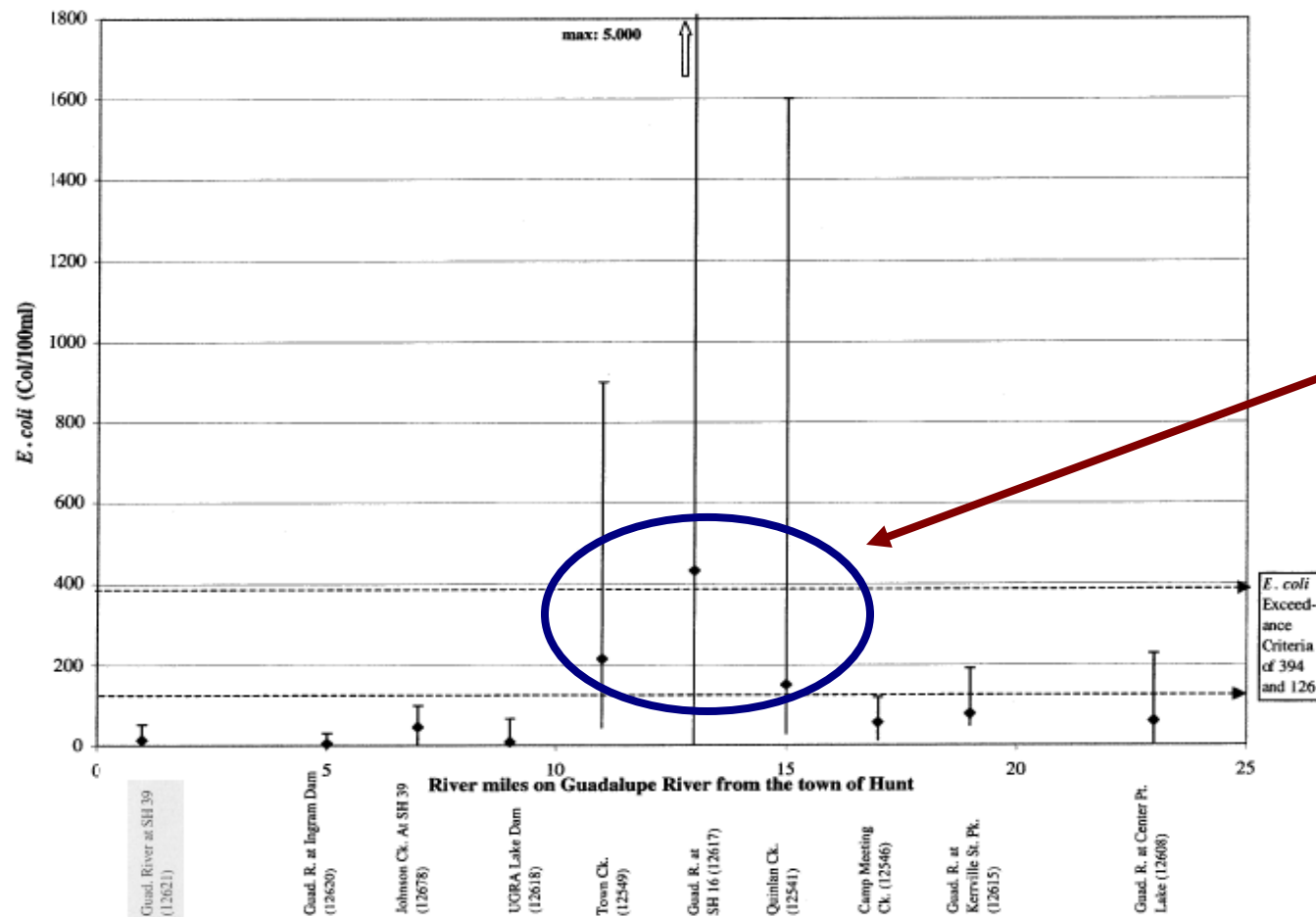


STATION	LOCATION	FECAL COLIFORM GEOMETRIC MEAN (Col/100 ml)	E. COLI GEOMETRIC MEAN (Col/100 ml)
12542	Quinlan Cr at IH10 (12542)	1671	162
12546	Camp Meeting Cr at Spur 100 (12546)	615	147
12615	Guadalupe R at Kerrville State Park (12615)	297	177
12611	Guadalupe R below Flat Rock Dam (12611)	262	28
12608	Guadalupe R at Center Point Lake (112608)	207	84
12543	Verde Cr near Center Point (12543)	364	126
12552	Cypress Cr at SH 27 (12552)	377	196
12551	Cypress Cr in Comfort (12551)	380	123



Routine Sampling Events – Feb – Aug 2005

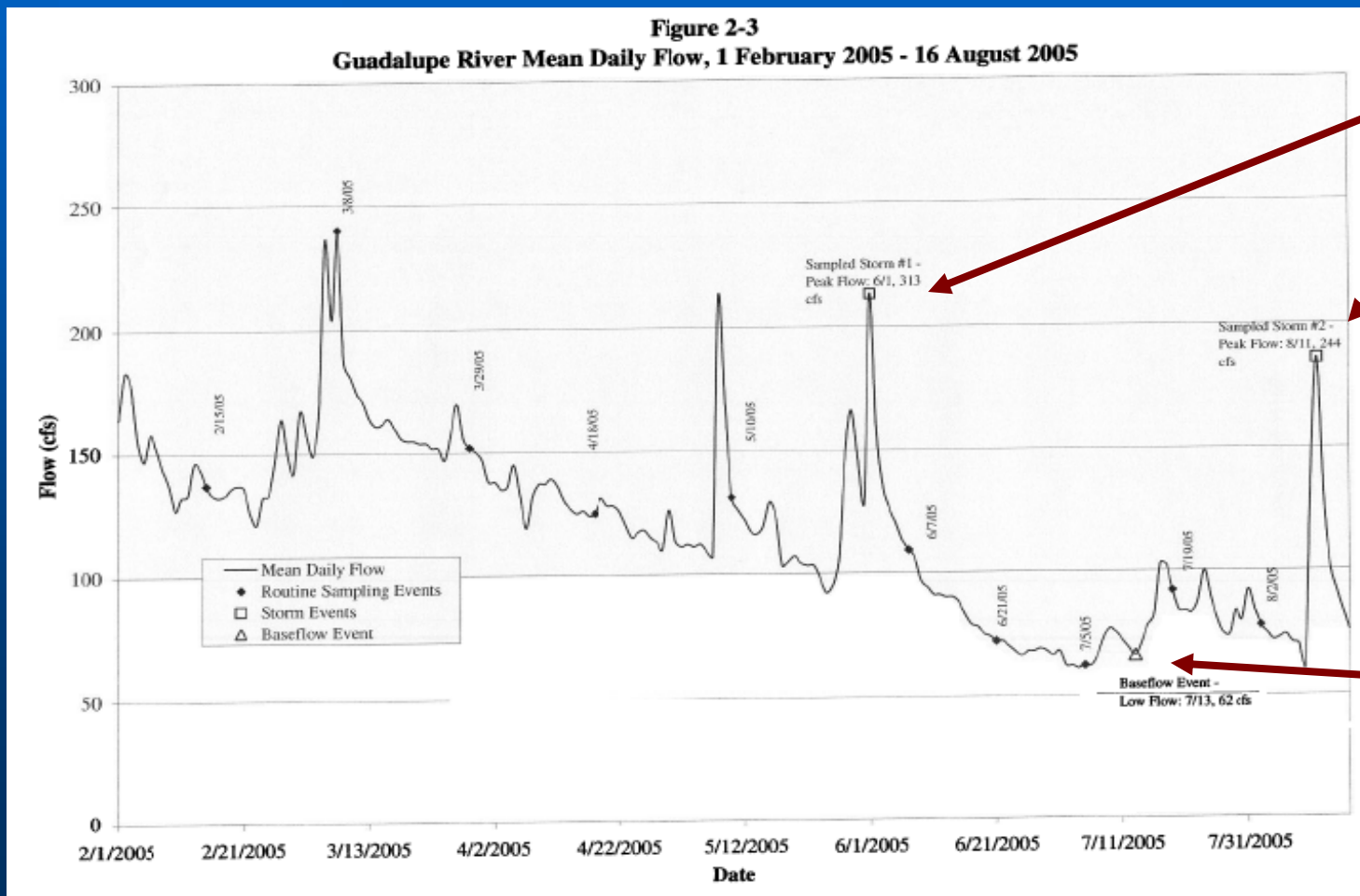
Figure 2-2
Guadalupe River *E. coli* Sampling Means, Routine Events of 15 February - 2 August 2005



Town Creek,
SH 16, and
Quinlan Creek



Mean Daily Flow – Feb – Aug 2005



1st Storm Event

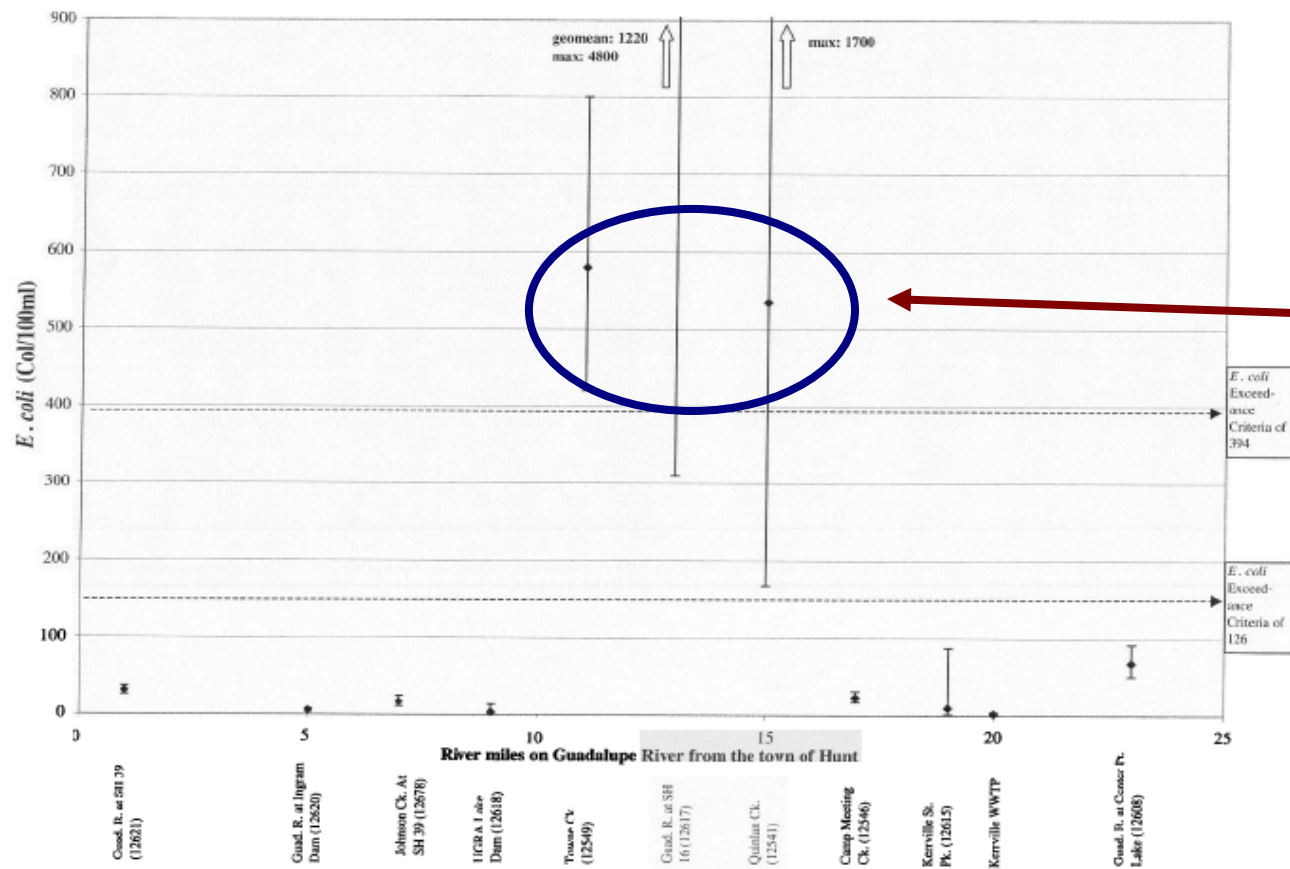
2nd Storm Event

Baseflow Event



Baseflow Event – July 13, 2005

Figure 2-4
Guadalupe River *E. coli* Sampling Means, Baseflow Event of 13 July 2005

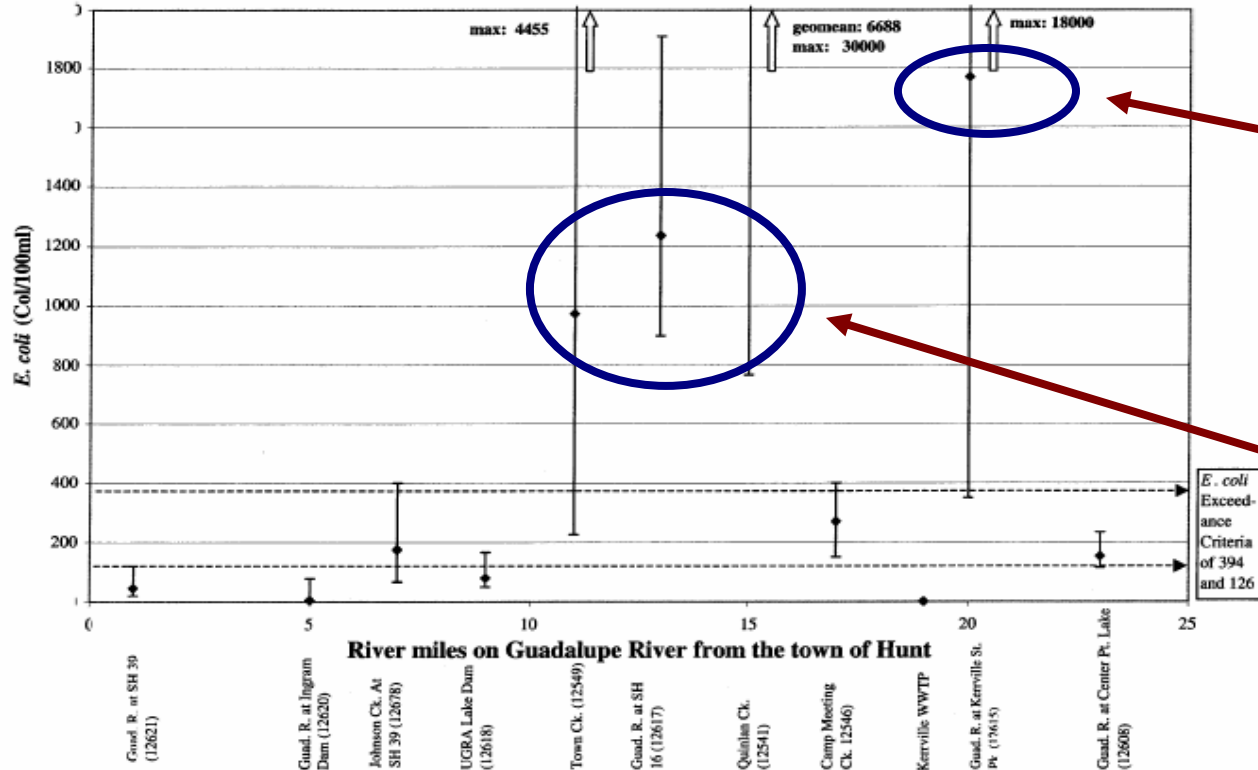


Town Creek,
SH 16, and
Quinlan Creek



Runoff Event – June 2005

Figure 2-6
Guadalupe River *E. coli* Sampling Means, Runoff Event of 1-2 June 2005



Kerrville
Street Park

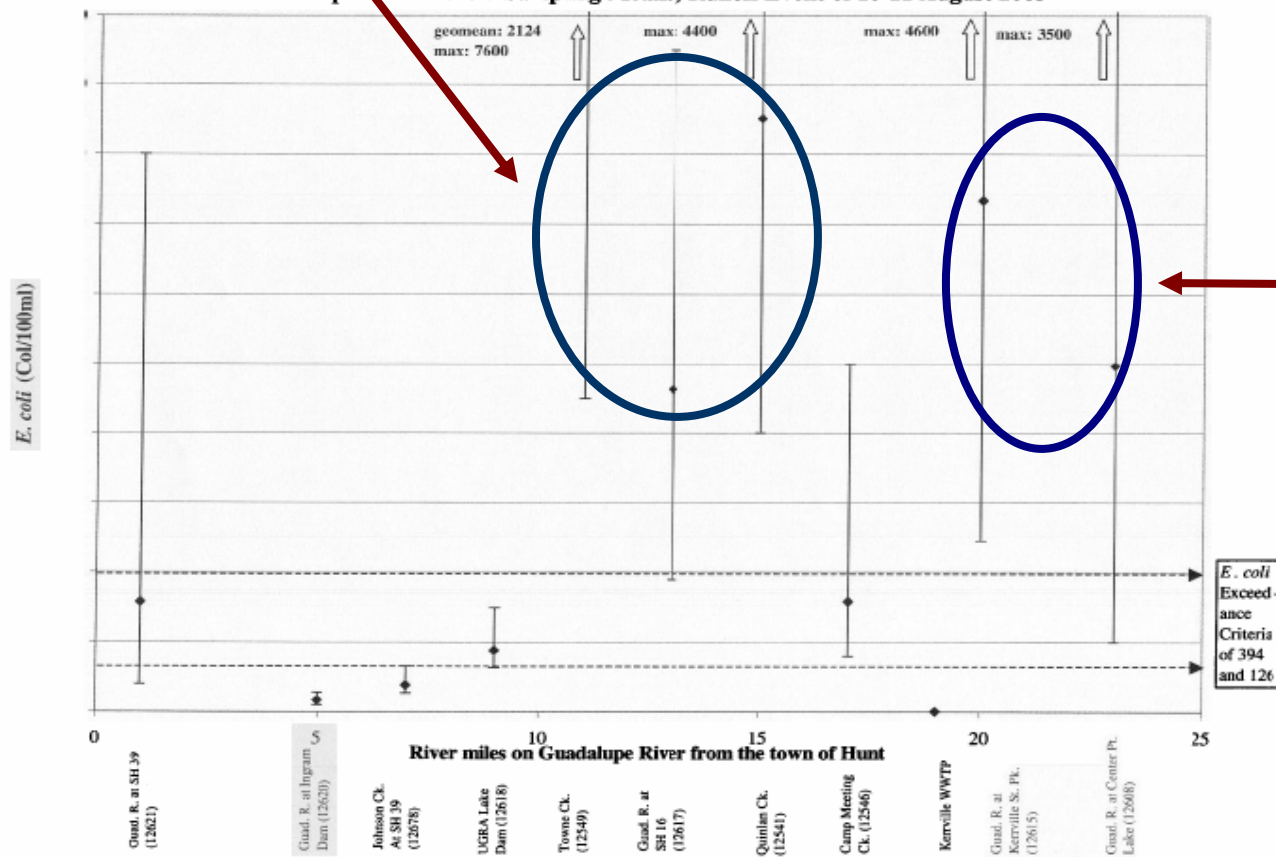
Town Creek,
SH 16, and
Quinlan Creek



Town Creek,
SH 16, and
Quinlan Creek

Runoff Event – August 2005

Figure 2-8
Guadalupe River *E. coli* Sampling Means, Runoff Event of 10-11 August 2005



Kerrville
Street Park
and Center
Point Lake



Bacteria Load Duration Curve Methodology

- Requires streamflow data, E. coli concentration data, and the relevant bacteria criterion (126/394 org/100 mL)
- Consider the following example:

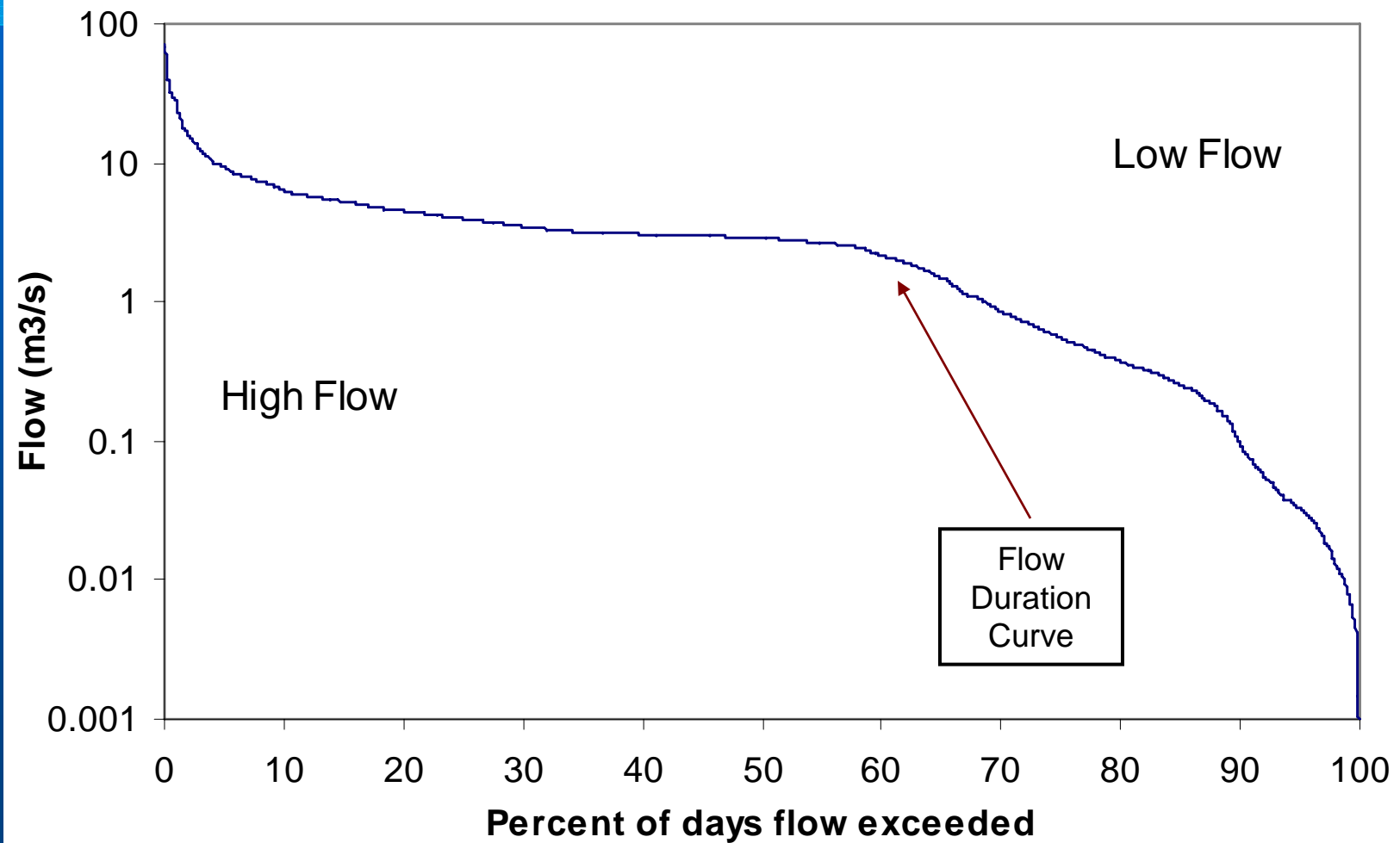


1st Step

- Establish a daily record of multiple years of streamflow ranked highest to lowest to create a flow duration curve.



1st Step - Result



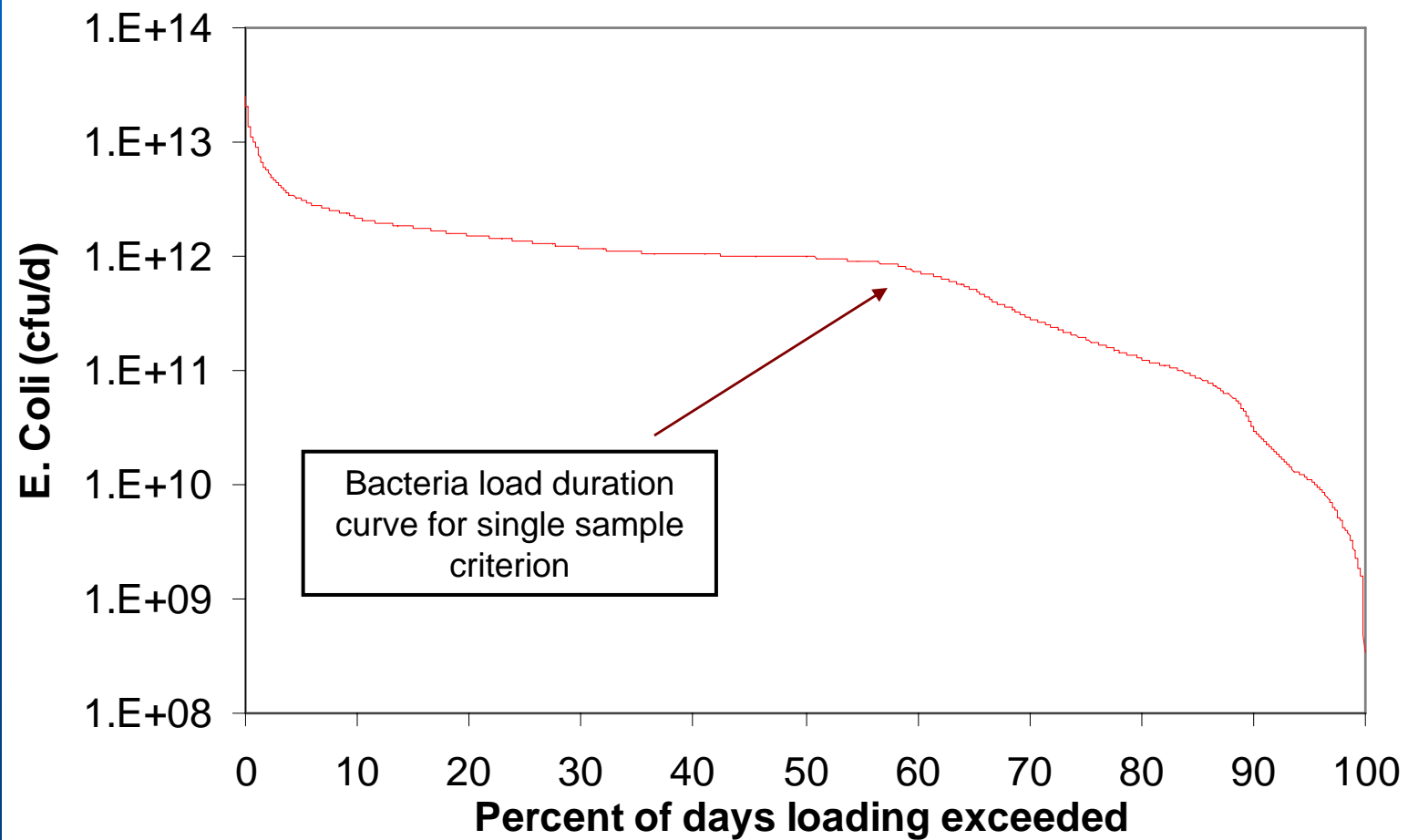


2nd Step

- The flow duration curve is combined by multiplication with a numeric criterion (for this example the single sample *E. coli* criterion of 394 cfu/100 ml.)



2nd Step - Result



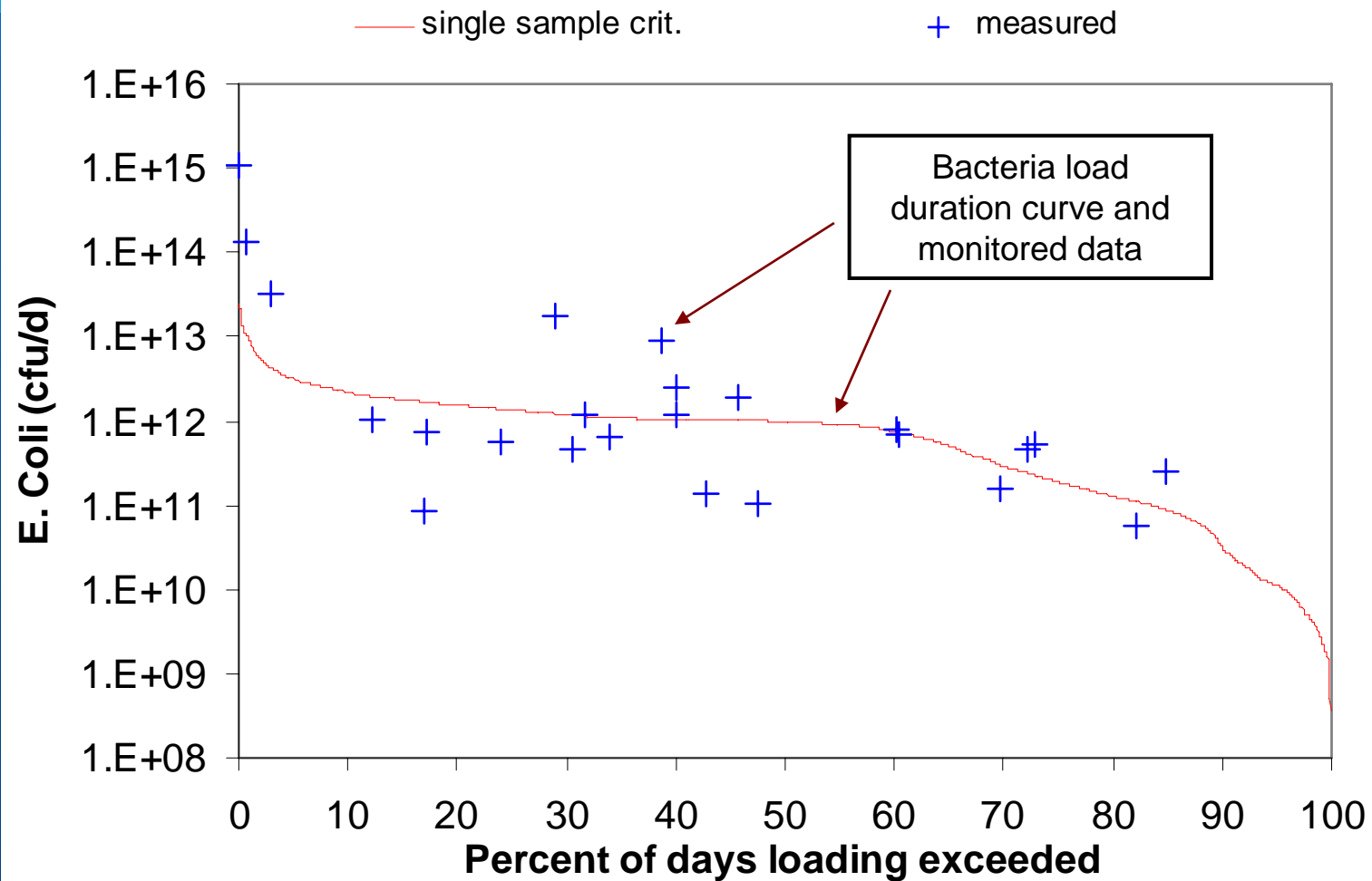


3rd Step

- The existing *E. coli* concentration data for specific days are multiplied by the streamflow on that same day.
- The data used are specifically those data for a respective water quality station.



3rd Step Results



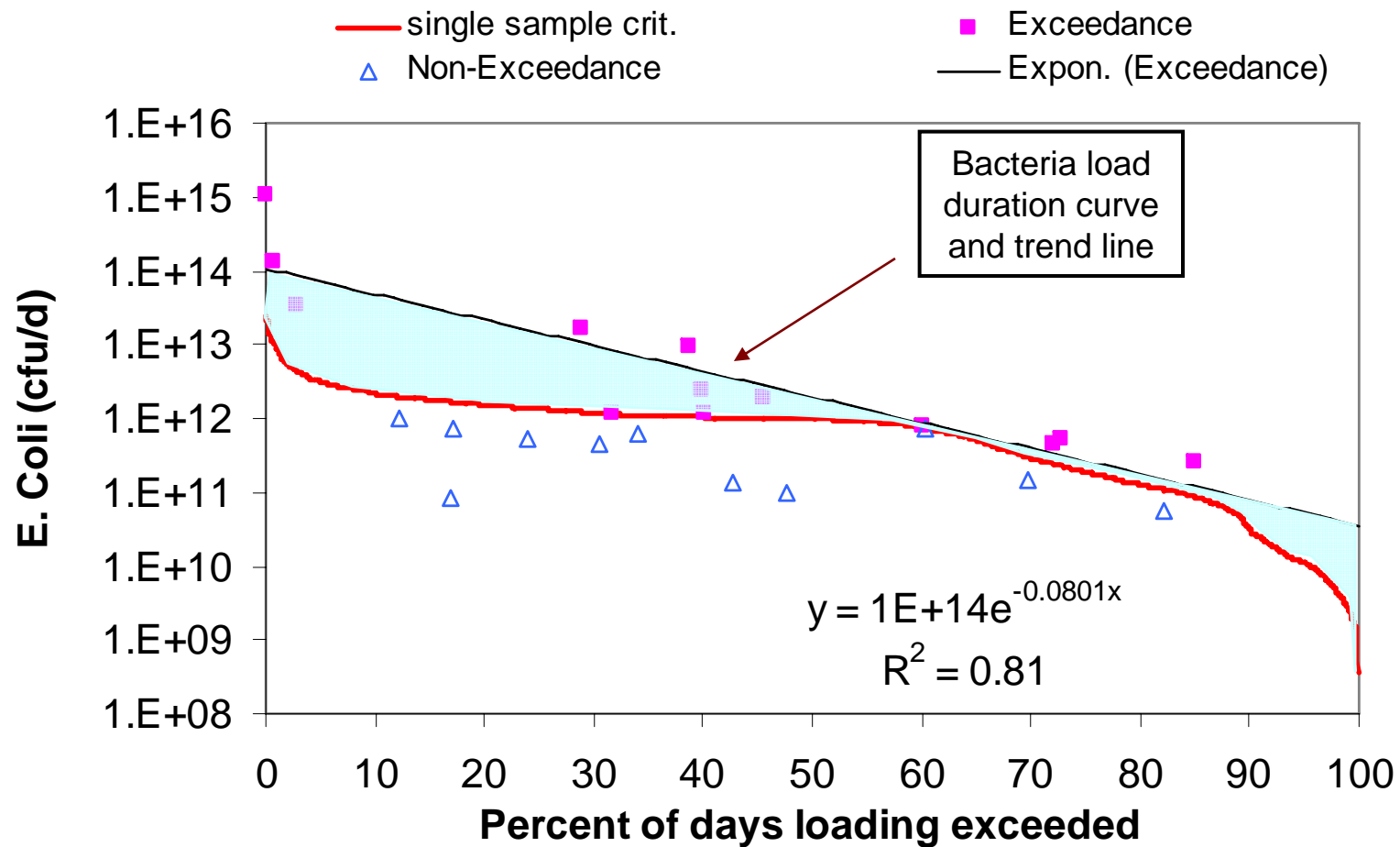


4th Step

- Use any one of several accepted procedures to determine exceedances to allow calculation of required percent reductions, which allows the allocation process to be quantified.
- For this example, the exceedances are determined by a **trend line** through all *E. coli* data that are greater than the criterion of 394 cfu/100 ml.

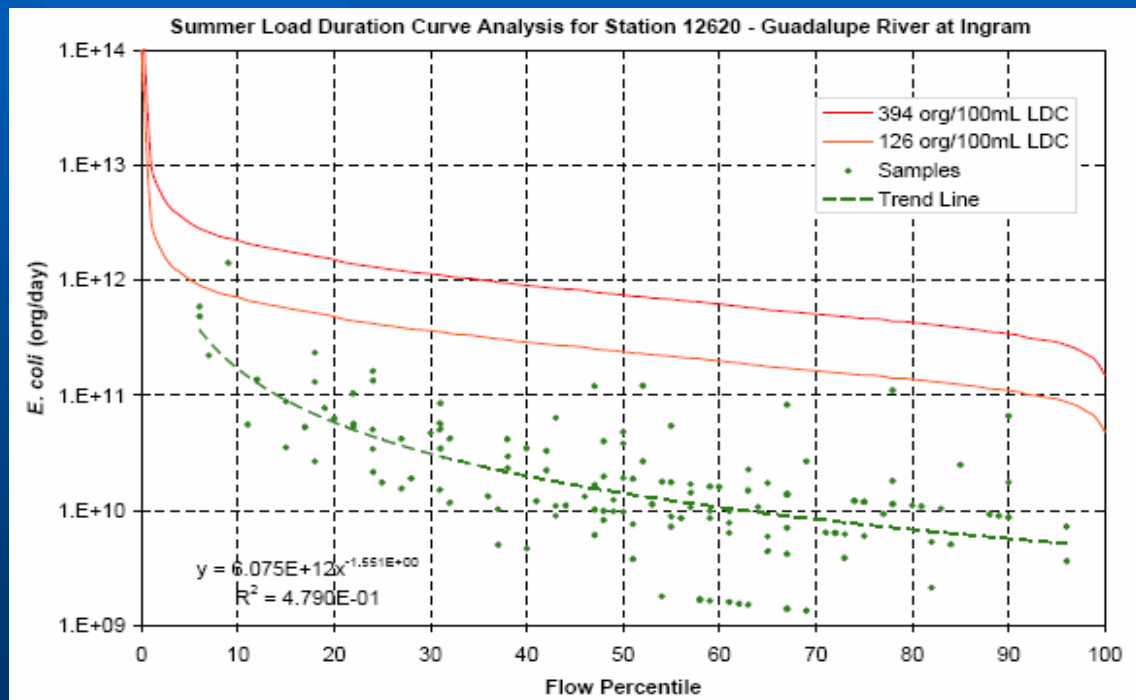


4th Step Results





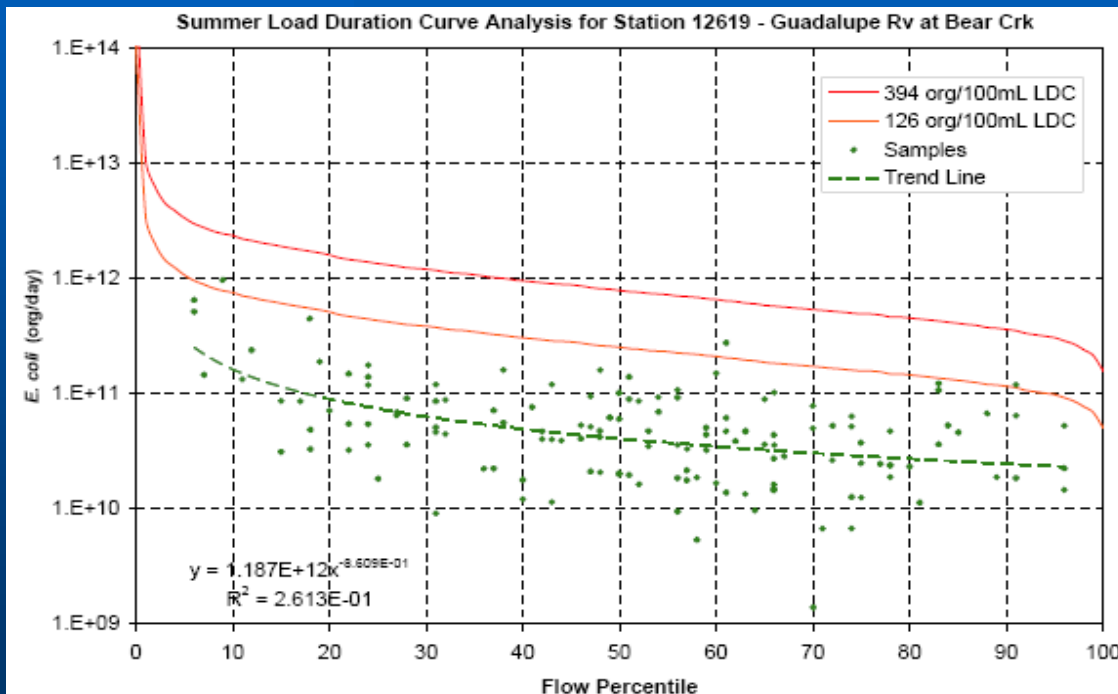
LDC for Station 12620 – Guadalupe River at Ingram



This station usually meets the state criteria. None of the historical samples exceeded the grab sample criterion of 394 org/100mL. All but one sample fell below the gm criteria of 126 org/100mL.



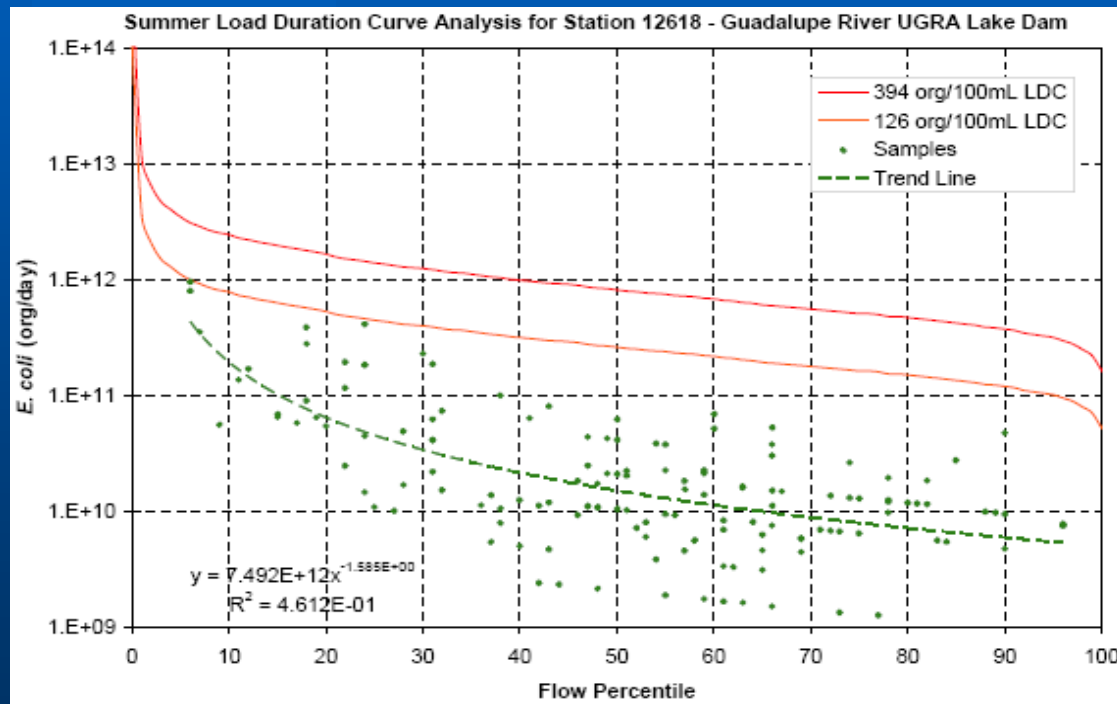
LDC for Station 12619 – Guadalupe River at Bear Creek



This station usually meets the state criteria. However, loads are higher under mid-range and low flow conditions than at the previous station. Also, this may be due to the fact that the previous station is at a dam site. Impoundments in this study seem to result in lower bacterial levels.



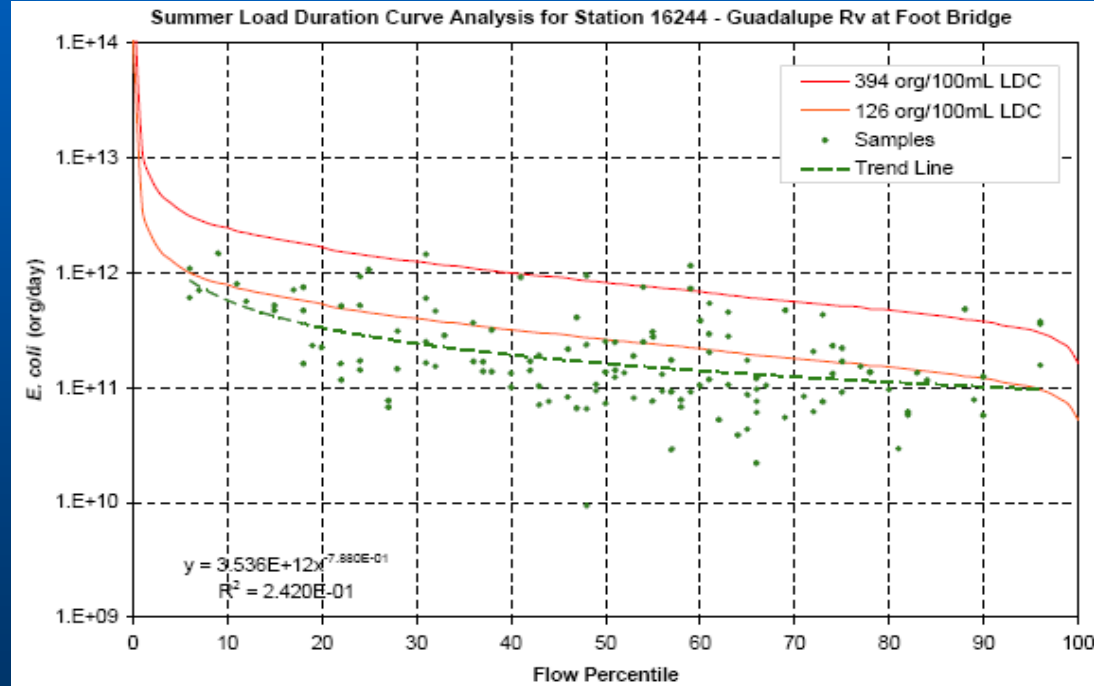
LDC for Station 12618 – Guadalupe River at UGRA Lake Dam



This station usually meets the state criteria. Loads associated with low and mid range flows are less than at the previous station. This reduction could be a result of bacteria removal that occurs as a result of the impoundment.



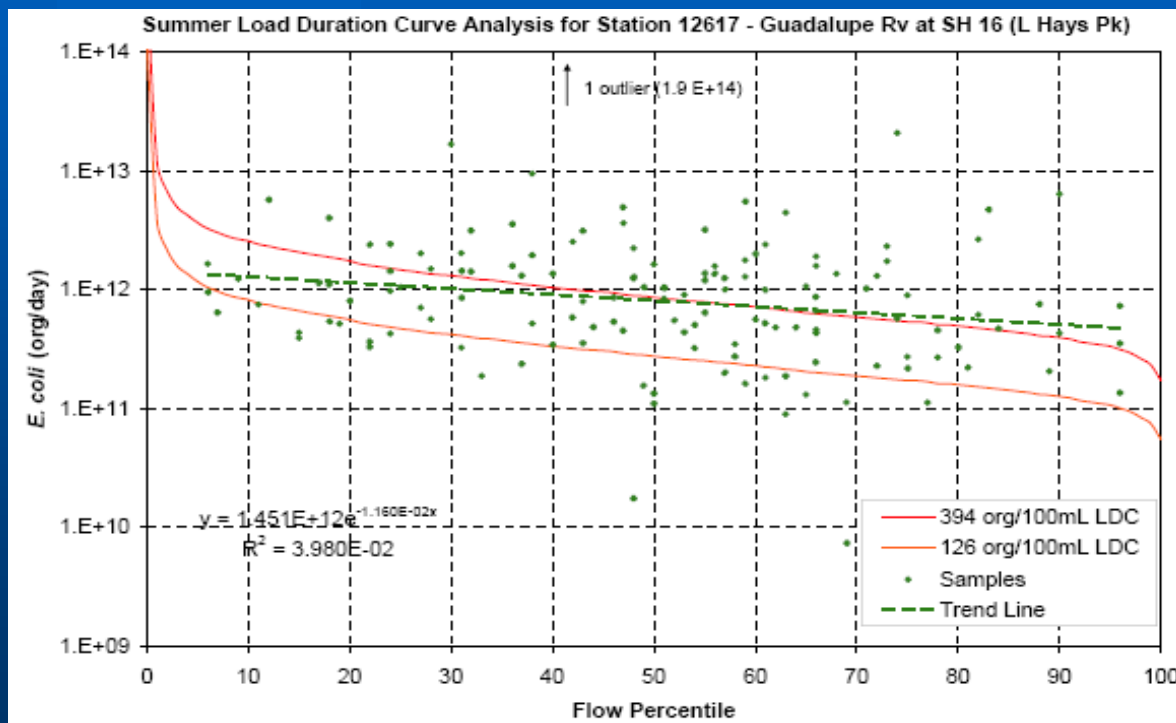
LDC for Station 16244 – Guadalupe River at Foot Bridge



Seven samples (5%) exceed the grab sample criterion and a **large number exceed the gm criterion**. Loads at low and mid range flows are 10 times higher than at the previous upstream station. This suggests that a significant dry weather direct source exists between the two stations.



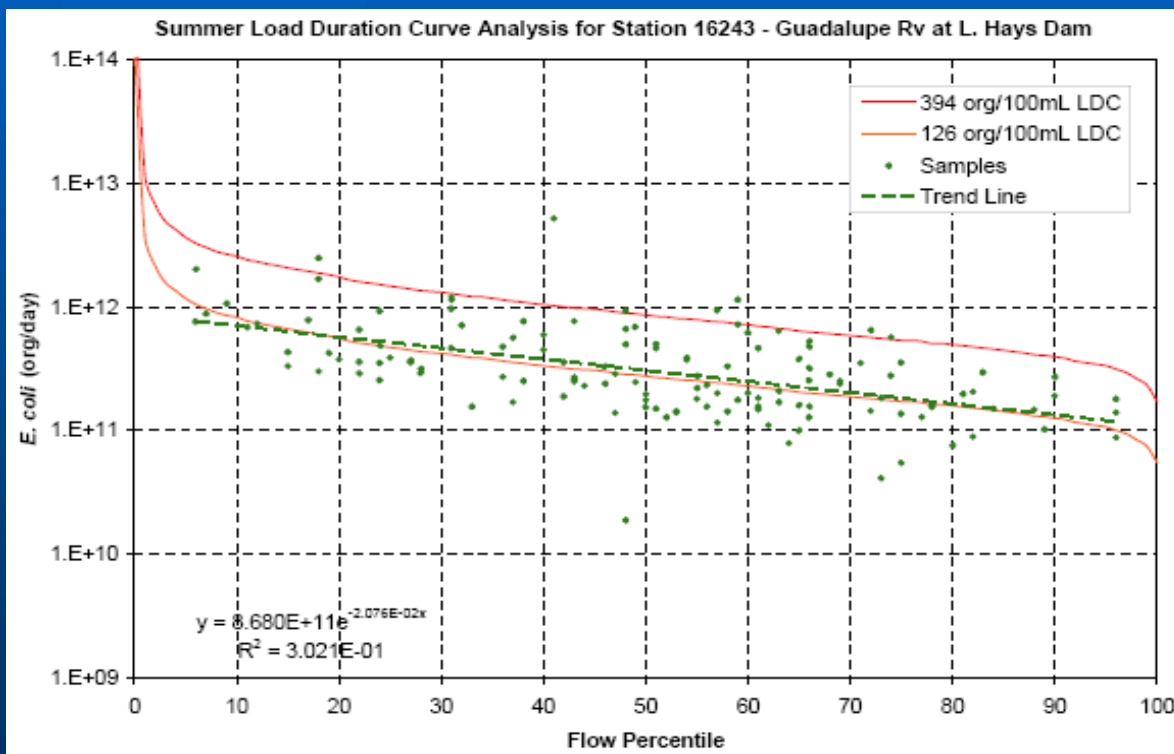
LDC for Station 12617 – Guadalupe River at Hwy 16 in L. Hays Park



Concentrations at this station are typically higher than at any other station in this study. 46% of the samples exceed the grab sample criteria. The greatest exceedances in criteria are now experienced during low flow. This suggests that the station is influenced by significant dry weather direct sources.



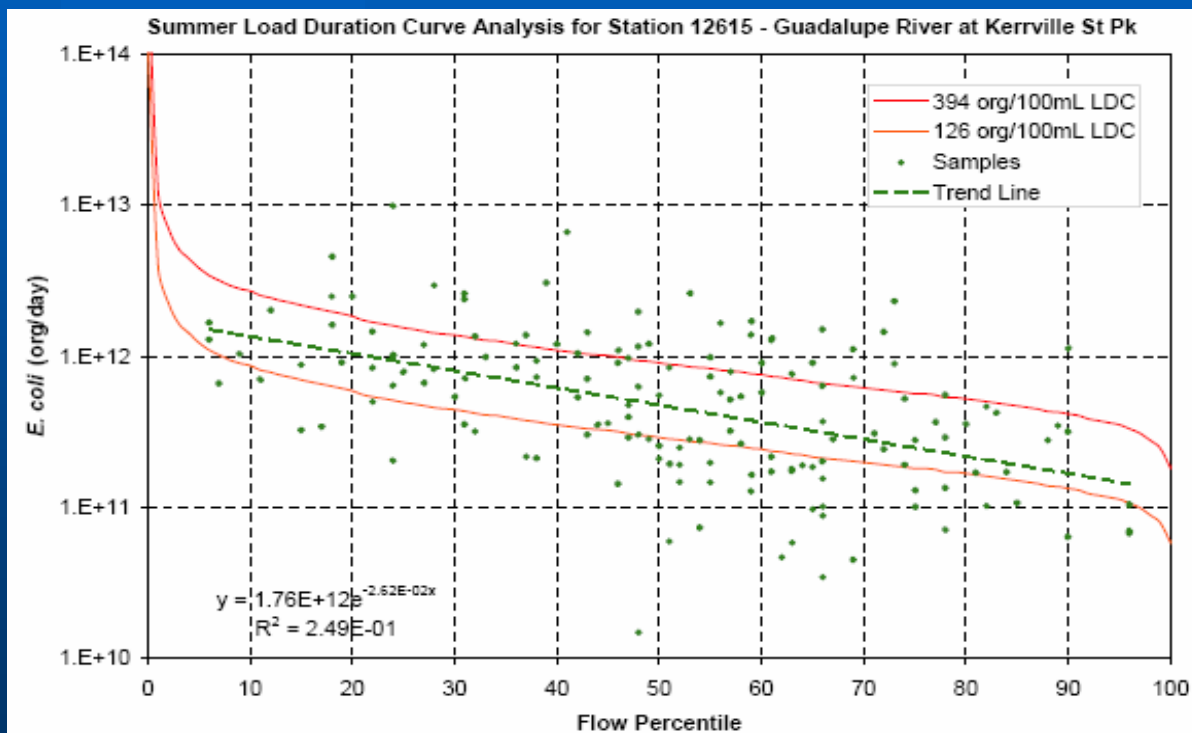
LDC for Station 16243 – Guadalupe River at L. Hays Park Dam



Just 7 samples, 5% exceed the grab sample criterion. However, the trend line suggests that the gm is often exceeded. The impoundment of water provided by the dam results in a positive influence on bacterial water quality. Previous stations at Ingram Dam and UGRA Dam also exhibited relatively low bacteria levels with relatively little scatter.



LDC for Station **12615** – Guadalupe River at **Kerrville State Park**



24% of samples exceed the grab sample criterion. The trend line is significantly higher than the gm. Loads are significantly higher than at the upstream station under both low flow and high flow conditions. This suggests that both dry weather and wet weather sources are likely to exist between L. Hays Park Dam and the State Park.



Bacterial Source Tracking (BST)

● Method: Ribotyping

- Genetic fingerprints of *E. coli* strains
- Genes that code for ribosome RNA
- Distinguish between different bacterial strains
- Lab Results from Source Molecular Corporation, Inc. - Miami, Florida



BST Methodology

- Two (2) methods were employed for comparison and classification of DNA fingerprints
- Bionumerics statistics program from Applied Maths, Inc. was used to assign a probable match for each isolate from the water samples to the isolates from the fecal source library
- Visual assessment of each individual band of every DNA fingerprint. Only isolate matches with a confidence level of 90% or more were accepted as probable matches.



Bacterial Source Tracking (BST)

- Library of Known Bacteria Types (scat): 100 samples, two (2) *E. coli* isolates from each source sample to develop a library of 200 isolates
- Unknown Water Samples: 50 samples collected from each of the four (4) BST stations



BST Water Samples (Unknowns)

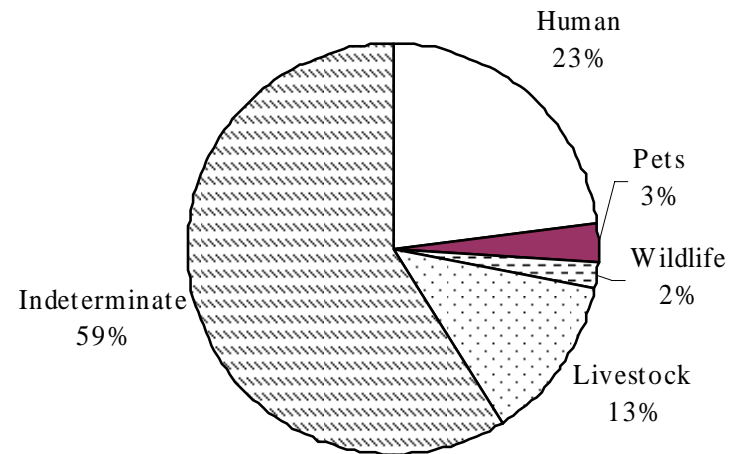
● Guadalupe River

- Station 12621 – SH 39 –50 Samples
- **Station 12617** – SH 16 in Kerrville– 50 samples
- **Station 12615** –Kerrville State Park– 50 samples
- Station 12546 – Camp Meeting Creek –50 samples



Bacteria Source Composition @ Station 12621 – Guadalupe River at SH 39

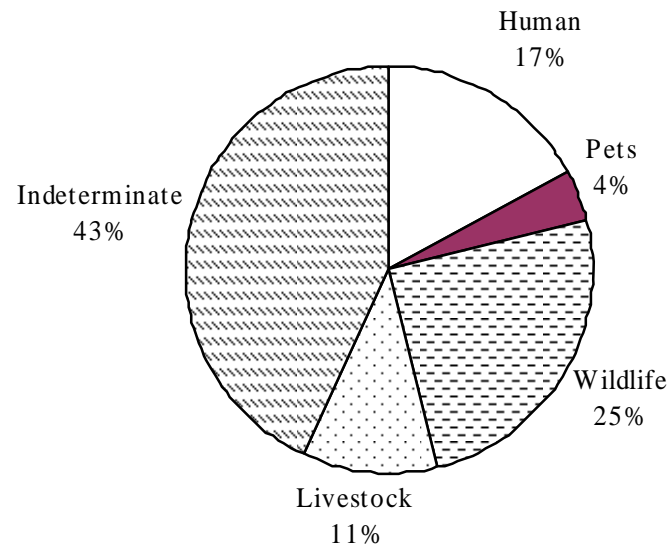
**Bacterial Source Tracking Results at Station 12621, Guadalupe River
at SH 39**





Bacteria Source Composition @ Station 16243 – Guadalupe River at L. Hays Park Dam

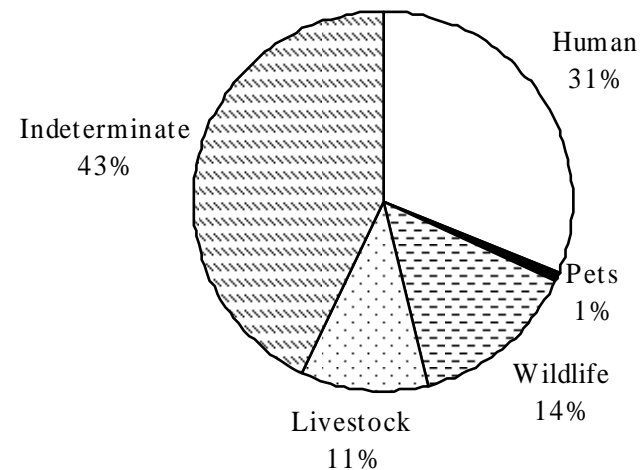
**Bacterial Source Tracking Results at Station 16243, Guadalupe River
at L. Hays Park Dam**





Bacteria Source Composition @ Station 12546 – Camp Meeting Creek

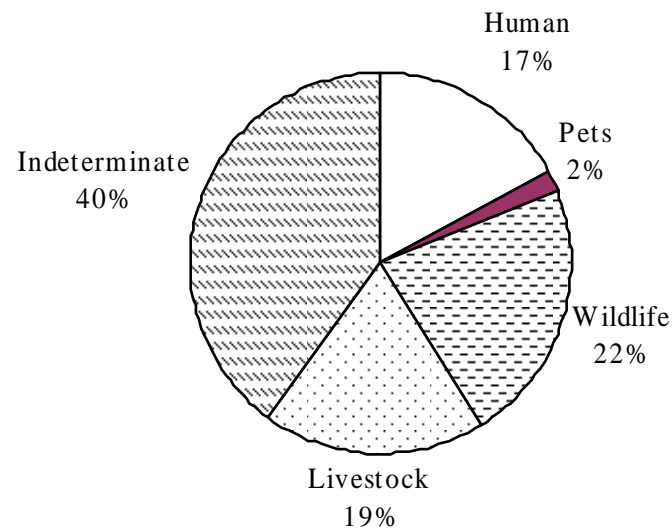
**Bacterial Source Tracking Results at Station 12546, Camp Meeting
Creek**





Bacteria Source Composition @ Station 12615 – Kerrville State Park

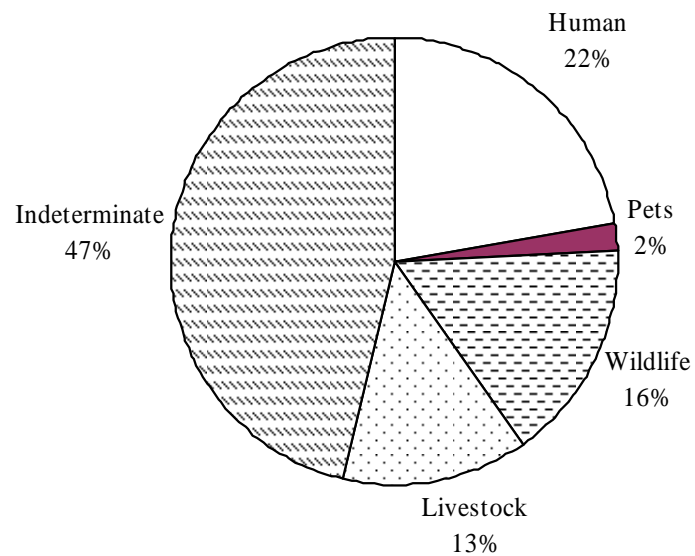
**Bacterial Source Tracking Results at Station 12615, Guadalupe River
at Kerrville State Park**





BST Results – All Stations Combined

Bacterial Source Tracking Results for All BST Stations





Questions / Concerns ?

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The project website can be located at:

<http://www.tceq.state.tx.us/implementation/water/tmdl/65-guadalupeabovecanyon.html>